



Original article

Traditional and ayurvedic foods of Indian origin



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ABSTRACT

The Ayurveda contains a wealth of knowledge on health sciences. Accordingly traditional foods and their dietary guidelines are prescribed in Ayurveda. There is so much similarity in ayurvedic dietetics and traditional foods that many of the traditional health foods in India can be called ayurvedic foods. This review article introduces the concepts of ayurvedic health foods in India and describes several traditional health foods across various regions of India. Recommended dietary guidelines according to age and health condition of the consumer, and seasonal considerations are presented for each of the traditional health foods of India. In the era of globalization of the population and international food trading, health conscious citizens around the globe will benefit from the wealth of knowledge on traditional Indian and ayurvedic health foods of Indian origin.

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1. Introduction

1.1. Indian view about health foods

Traditional Indian foods have been prepared for many years and preparation varies across the country. Traditional wisdom about processing of food, its preservation techniques, and their therapeutic effects have been established for many generations in India. Food systems can deliver numerous biological functions through dietary components in the human body. Indian traditional foods are also recognized as *functional foods* because of the presence of functional components such as body-healing chemicals, antioxidants, dietary fibers, and probiotics. These functional molecules help in weight management, and blood sugar level balance and support immunity of the body. The functional properties of foods are further enhanced by processing techniques such as sprouting, malting, and fermentation [1].

At different stages of life, the constitution of the human body changes and it requires unique eating habits to sustain normal physiological functions. As indicated by these diverse stages, our

ancestors had different foods that were healthy and nutritionally dense. Dating back to Indian civilizations and Indian old literature, namely *Bhagavadgita*, *Ramayana*, and *Manusmriti*, every community that lived in India had a clear and separate food belief system. Most of these, however, have been influenced by Aryan beliefs and practices. According to Aryan belief, food was considered as a source of strength and a gift from God [2].

Aryans are a heterogeneous group of people who lived in different parts of ancient India. They migrated from Indo-Iranian borderlands with their cultures and customs. The early stage of their settlement with their religious tradition in India is known as the Vedic period. Later the ruling classes in their regions were drawn to the Vedic religion [3]. In the Vedic period, knowledge, prayers, religious songs, and poems were written, which came to be known as *Vedas*. The *Vedas* are an important class of religious texts in Indian literature. The four *Vedas*, namely *Rigveda*, *Samaveda*, *Yajurveda*, and *Atharva veda*, describe different cereal grains and their use in our daily life. Aryans believed that food was not simply meant for body nourishment, but was the basic part of a cosmic moral cycle [2]. Barley became the Aryans' initial staple food, and is also mentioned in the *Rigveda*. Later texts mention wheat, lentils, millets, and sugarcane. The most popular lentils used were red lentils, green lentils, and black lentils. *Apupa* is a form of cake prepared by frying barley. *Kichadi* made from rice together with lentils or *dal* is highly nutritious. Aryans knew about rice

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cultivation; parched rice and cereals were a common method of processing during their period. Lentils and rice were the combinations of complementary nutritional elements consumed by Aryans [3]. The literature of Buddhists and Jains reveal the extensive use of rice and its gruel. During the Jain period, cloth was soaked in milk and dried to yield a reconstituted product called *kholas* [2,4].

Traditionally, Indian foods are classified into three main categories. Cooked vegetables, milk, fresh fruits, and honey are meant for the truly wise and are considered as *Satvika* foods. Foods that bring out the lowest, crass qualities of human behavior such as meat, liquor, garlic, and spicy and sour foods are classified as *Tamasika* foods. Foods that give enough energy to carry out daily work are categorized as *Rajsika* foods [5]. Aryans classified food materials on the basis of their nature and use such as *Sukhadhanya* (cereals), *Samidhanya* (pulses), *Phala* (fruits), *Shakna* (vegetables), *Payovarga* (milk products), *Madhyavarga* (alcoholic beverages) and *Mamasavarga* (animal products) [2].

Food is specific to season. India has six different seasons, namely *vasanta ritu* (spring), *grishma ritu* (summer), *varsha ritu* (monsoon), *sharad ritu* (autumn), *hemanta ritu* (fall winter), and *shishira ritu* (winter). Studying and knowing about seasons is important to make an efficient diet plan for an individual and hence in this review, effort is made to provide the details of individual foods and their seasonal usage.

1.2. Concepts of Ayurveda in health foods

Ayurveda is a traditional system of medicines native to India. In Ayurveda, regulation of diet is crucial, since it examines the whole human body as the product of food. Ayurveda illustrates how an individual can recuperate by establishing the connection between elements of life, food, and body. According to ayurvedic concepts, food is responsible for different aspects of an individual including physical, temperamental, and mental states. To stay healthy, maintaining a stable healthy diet routinely is essential. The body absorbs the nutrients as the result of digestion. But Ayurveda states that the food first converts into *rasa* (plasma), and then followed by successive conversion into blood, muscle, fat, bone marrow, reproductive elements, and body fluids [6]. Imbalance of mind, body, and spirit are referred to as diseases. Ayurveda has different treatments for different diseases, which are well established and consistent over the period. Multiple therapeutic approaches exist in ayurvedic science such as *Shodhana*, *Nidan Parivarjan*, *Shamana*, *Rasayana*, *Pathya vyavastha*, and *Satvajaya*.

Shodhana therapy is a type of purification treatment where toxic factors are eliminated from foods by the application of various unit operations. Peeling, polishing, sorting, cleaning, cleansing, sifting, straining, de-husking, washing, and distillation are different techniques used in *Shodhana* therapy. According to *Shodhana* therapy, the unit operations are designated with different nomenclatures. For example, frying process of Hingu (*Asafoetida*) with *ghee* to eliminate moisture is called *Bharjana*. Cleansing and sifting of cumin and mustard seeds is known as *Virecana*. Removal of ginger (*Zingiber officinale*) outer skin through washing is known as *Svedana* [7]. This therapy not only removes the impurities but also improves the nutritional value of foods.

Nidan Parivarjan treatment mainly considers avoiding of known causative factors for a disease. The causative factors are mainly classified as four categories in Ayurveda, namely *Asaratmaka* *Nidana* (dietary), *Viharatmaka* *Nidana* (regimens), *Manas* *Nidana* (psychological), and *Anyan* *Nidana* (others). Overeating, over nourishing (*Santarpana*), heavy food, sweet food (*Madhura*), cold diet (*Sheetha*), meat (*Mamsa*), and unctuous food (*Snigdha*) are some of the dietary factors for obesity [8].

Shamana therapy is a palliative treatment that involves restoring of imbalanced doshas (humors) to a normal state without affecting or impairing of other doshas. In order to restore the *doshas*, appetizers, exercise, digestives and exposure to fresh air, sun, meditation, and fasting are performed [6].

Rasayana therapy is an immunomodulator and rejuvenation medicine-based treatment. This therapy aims to improve body immunity to different diseases. All *rasayanas*, in general, are nutrition promoters that act through three primary mechanisms. They are *Rasa* enhancers, *Agni* enhancers, and *Srotas*. *Rasa* enhancers have direct nutrient effects, *Agni* enhancers promotes digestion power, and *Srotas* promotes nutrient circulation. *Aswagandha*, curcumin, garlic, ginger, and neem play significant roles in *Rasayana* therapy [9]. *Rasayanas* are also organ and tissue specific, classified as *Medhya Rasayana* (brain treatment), *Hridaya Rasayana* (heart treatment), *Twacya Rasayana* (skin treatment), and *Caksusya Rasayana* (eye treatment) [10].

Pathya vyavastha treatment mainly emphasizes on diet, activity, habits, and emotional status of the mind and body. Ayurveda considers food as the first and foremost tripod (food, sleep, *brahmacharya*) of life. Hence, a proper diet should be considered, which is essential for good health and healthy body functions. *Pathya vyavastha* mainly gives knowledge about foods in different diseases. It is done with the view of enhancing the therapeutic effect of diet, which stimulates the digestion power, and helps in digestion and assimilation of food [11,12].

Mental health is essential for a healthy person. Stimulation of patient mind helps in relaxation through reduction in stress and indirectly improves other body activities [13]. As per Ayurveda, proper food selection and dietary schedule helps to control the mind and consequently maintain holistic health and happiness.

2. Grain-based traditional health foods

Grains are the primary staple food of India. Grains are a nutritionally rich product and deliver recommended nutrients to the body. Consumption of grains in different civilizations of India can be observed from the literature. In Indian history we can discover distinctive grains used by our ancestors. Beginning with Yajurveda, the three pulses urad (*Vigna mungo*), mung (*Vigna radiata*), and masoor (*Lens culinaris*) were the most commonly used grain legumes [2]. All grains have good calorific value, largely from starch and proteins. Some of the grains exhibit antinutritional properties such as the presence of trypsin inhibitors [14]. Traditional processing techniques such as fermentation, soaking, and cooking help to remove these antinutritional factors [14]. In view of health, resistant starch received attention because of its potential health benefits and functional properties. Many traditional Indian grain products may contain higher amounts of resistant starches because of higher proportions of whole grain ingredients and less intensive processing [15]. Some of the traditional grain-based health foods with their functional and health benefits are discussed below.

2.1. Idli

Idli is a fermented product prepared from rice and black gram batter by steam cooking [16]. *Idli* is a white colored, small, round, and spongy product (Fig. 1). In 1485 and 1600 CE, *idli* was compared to the moon, which suggests that rice was in use. Use of rice along with pulses is necessary as a source of mixed natural microflora needed for efficient fermentation [2]. Black gram (*Phaseolus mungo* L.) is the primary ingredient having natural fermentation microflora and acts as the substrate for the fermentation of batter. Sour buttermilk is also used as a source of microorganisms [17]. Black gram and rice are used in the ratio of 1:2 during batter preparation.

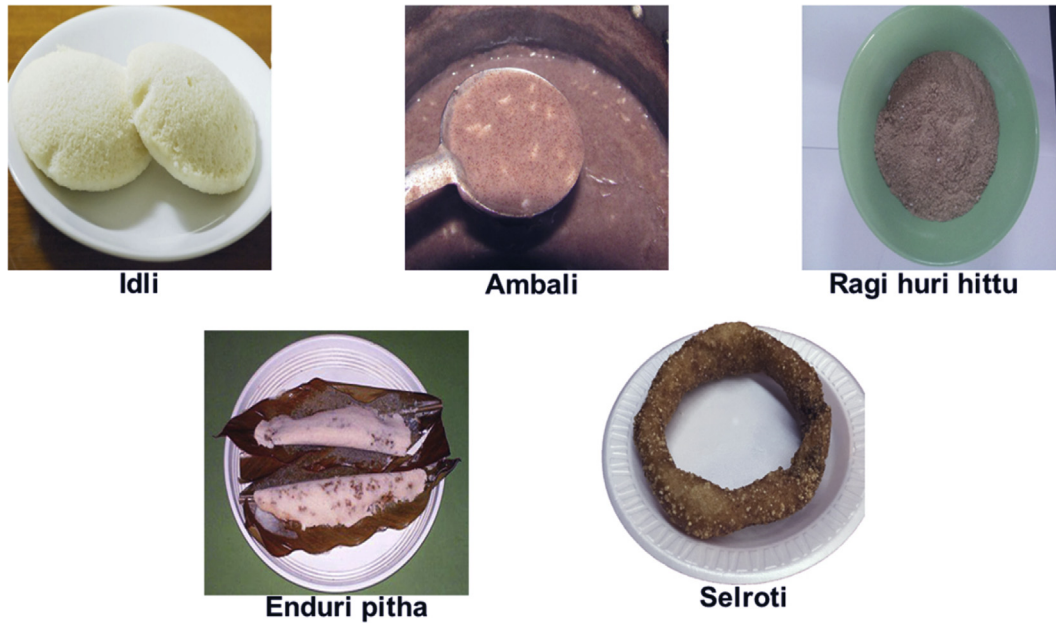


Fig. 1. Grain-based traditional health foods.

Fermentation of *idli* batter improves the nutritional and protein efficiency value [18]. Leavening is the primary objective of fermentation in *idli* preparation. The major microorganisms involved in the leavening process are heterofermentative lactic acid bacterium, *Lactobacillus mesenteroides*. The acidity of the batter is regulated by homofermentative lactic acid bacterium *Streptococcus faecalis* [19]. In addition to these, probiotic microorganisms such as *Lactobacillus plantarum* and *Lactobacillus lactis* are also present in *idli* batter. These microorganisms can produce vitamin B₁₂ and β -galactosidase enzyme, which enhances the probiotic activity and promotes health [20]. *Kadubu* (plate *idli*) is another type of *idli* prepared by steaming *idli* batter in a plate, hence the *kadubu* is large. *Idli* is suggested in all seasons and is used as a breakfast food. It adds good amount of protein to the daily diet. Due to the fermentation process, *idli* is more digestible and is recommended to all age groups.

2.2. Dosa

Dosa is another fermented dish like *idli* mainly found in the south Indian region. It is a highly seasoned pancake, contains rice and black gram as primary ingredients. To improve the nutritional quality of *dosa*, finger millet and horse gram can be used as primary ingredients [21]. During fermentation, the volume of the batter doubles and as fermentation time increases, the protein content of batter increases [22]. Regional names of *dosa* differ across India. In the state of Odisha, the dish called *chakuli* resembles *dosa*. Primary ingredients in *chakuli* batter are parboiled rice and black gram. Spices, such as ginger, and onion are added while seasoning [23]. *Susupe dosa*, another type of *dosa*, is prepared from the boiled red raw rice. Preparation of *susupe dosa* includes grinding boiled red raw rice with aniseed, palm jaggery, and salt followed by soaking for 4–5 hours in water. After soaking it is cooked in *dosa* pan. For the purification of lactating women's blood, it is advised to give at least three *susupe dosas* twice a day without rice gruel (*ganji*) [24]. *Dosa* is a breakfast food in south India. It is more digestible and nutritionally dense, and hence is recommended to elderly people and children younger than 10 years. It is consumed with *palya* or curry in all seasons.

2.3. Ambali

Ambali is a finger millet-based fermented semi-liquid product of south Indian states, Karnataka and Tamil Nadu. Preparation method includes mixing of finger millet flour with water to make a thick batter and followed by cooking and fermentation (Fig. 1). The fermentation process decreases the leucine to lysine ratio (from 3.6 to 4.1) and increases the concentration of thiamin, riboflavin, and tryptophan and bioavailability of minerals. Leucine to lysine is an indicator of pellagragenic character of protein [25–28]. The dominant microorganisms responsible for the fermentation of finger millet are *Leuconostoc mesenteroides*, *Lactobacillus fermentum* (1.6×10^9 colony-forming units/g), and *S. faecalis* (8×10^8 colony-forming units/g) [29]. *Ambali* is considered a geriatric food because of the presence of high calcium and low resistant starch in finger millet [30]. *Ambali* is consumed as such, or with buttermilk for taste. Consumption of *ambali* in winter and rainy season should be avoided because it is very cold (endothermic) in nature. It consists of sufficient amount of calcium and is a healthy drink for elderly people.

2.4. Ragi hurihittu

Ragi hurihittu is the flour of popped finger millet, rich in dietary fibers and nutrients (Fig. 1). Popping is a simple processing technique done by severe heat treatment. It improves the aroma and taste and decreases antinutritional factors and increases the digestibility and solubility of starch because of gelatinization [31]. Since finger millets are small in size and difficult to de-bran when popped, it increases the total dietary fiber content in the final product. The flour is used for the preparation of ready-to-eat malts (weaning foods). The major reason behind the high nutritional value of *ragi hurihittu* is the presence of high reducing sugar concentration and amylase enzyme activity of finger millet. *Ragi hurihittu* is composed of slow cell wall degradation components, which are useful in preparation of fiber-rich foods [32]. To enhance the nutritional value of *hurihittu*, finger millet is germinated, which improves the bioavailability of iron and zinc. It can be used for the preparation of dietetic foods for anemia patients and geriatric food formulation [33].

2.5. Enduri pitha

Enduri pitha is a flavoured cake, native to Odisha state, prepared during the prathamastami festival. It is prepared by steaming of the fermented batter of parboiled rice and black gram in a turmeric leaf and folding the leaf through the mid-vein (Fig. 1). The batter-filled folded leaves are then cooked over steam. Black gram proteins are deficient in methionine and cysteine amino acid, this lowers the biological value of proteins and fermentation seems to enhance the nutritional quality of the blend of black gram and rice [34]. Other ingredients such as coconut, curd, and sugars are added. It is recommended to all age groups. The extracts of turmeric leaves through this traditional food in winter season increase the immune system of the body [23].

2.6. Dhokla

Dhokla is indigenous probiotic breakfast food found mainly in Gujarat state. *Dhokla* is prepared from the fermentation of Bengal gram and rice. The method of preparation is the same as idli, but it is steamed openly rather than covered as is done in idli preparation [35]. During fermentation, lactic acid bacteria contribute to the acidity of the product and make it sour in taste and improve the flavor. Yeast is used for the culture since it produces folic acid and helps in making food spongy by increasing the batter volume [36]. Compared with the unfermented batter, the antioxidant property of fermented batter is high. Intake of free fatty acid and hyperglycemia condition in diabetic patient causes increase in oxidative stress [37]. the antioxidant property of *dhokla* helps in curing age-related diseases and oxidative stress-induced degenerative diseases [38]. Hence *dhokla* can be a good food item in the diet menu of diabetic patients.

2.7. Hawaijar

Hawaijar is an alkaline-fermented soybean product consumed daily as a source of protein in Manipur. It is nonsalted and has a characteristic flavor and stickiness [39]. The organism mainly involved in the fermentation of this product is *Bacillus* spp. [40]. During the preparation of *hawaijar*, bamboo baskets, banana leaves, or healthy fig leaves are used, which helps in fermentation and results in better quality of product. *Hawaijar* consists of soluble proteins ranging from 26% to 27% [41]. Presence of *Bacillus* spp. gives high fibrinolytic activity to the product [42]. Since *hawaijar* is rich in proteins, it is recommended for adults and children older than 10 years.

2.8. Selroti

Selroti is a rice-based fermented food, which is spongy and ring shaped (Fig. 1). It is consumed in Sikkim and Darjeeling. A local variety of rice is used for its preparation. Rice or rice flour is soaked overnight in cold water and then water is decanted. Soaked rice is pounded into small powder using wooden mortar and pestle. Then the rice is mixed with wheat flour, sugar, butter, and condiments such as cloves, cardamom, coconut, nutmeg and cinnamon. Milk or water is used for kneading the powder into soft dough for easy flow. The batter is left to ferment at ambient temperature for 2–4 hours followed by molding into a ring and fried. It is served as a confectionary product [43]. The nutritive value of *selroti* is similar to idli and has good amount of digestible proteins. *Lactobacilli*, *Pediococci*, *Enterococci*, and *Leuconostocs* are the principal microorganisms present in *selroti* [44].

3. Fruit and vegetable-based traditional health food

Fruits are good sources of flavonoids, minerals, vitamins, carotenoids, electrolytes and other bioactive compounds that have impact on human health. Some of the traditional health foods prepared in India using fruits and vegetables and their health impact are discussed below.

3.1. Banana

Banana is a delicious fruit used in India mostly as prasada (spiritual food). The different parts of banana plant used are fruit, flower, and stem. Ripe banana fruit is used for treating gastric problem, since it is alkaline in nature, neutralizes the acid conditions and helps in formation of thick protective mucus layer [45]. Banana fruits are rich in iron, hence it can be recommend to women who are suffering from anemia [46].

Banana leaves are traditionally used for serving other foods in south India. They add good aroma to hot foods during eating and are good source of antioxidant such as epigallocatechin gallate [47]. Idli made by steaming on banana leaves is common in south India, especially in south Karnataka. In north Karnataka and Kerala region, food products such as leafy vegetables and small fruits and vegetables are kept between banana leaves of live plants to maintain freshness [48]. Traditionally, the Pundits of villages use the leaf and banana stem extract for treating different ailments. The main health dishes made from banana plant parts are *bale dandu palya*, *vazhai poo poriyal*, and banana stem juice, which are used mainly for diabetic treatment.

3.1.1. Bale dandu palya

Bale dandu palya is a food made from the stem of banana plants (Fig. 2). It is mainly consumed in Karnataka and Tamilnadu regions. The stem is cut into pieces and made into cubes and boiled, followed by seasoning with chili, salt, coriander, curry leaves, grated coconut, and turmeric powder. It is taken directly or with *dosa*, *chapati*, or *idli*. It is good for diabetic patients and also those who are suffering from stomach problems [49].

3.1.2. Banana stem juice

Banana stem juice is extracted by pressing of innermost trunk of the stem and is taken in empty stomach in the morning. The juice is used for massage, which helps good skin health. The juice has hypoglycemic effects and can be used for treating hypoglycemia [50].

3.1.3. Vazhai poo poriyal

This is a dish made from the flower of banana plant (Fig. 2), which is taken and the floret is separated followed by removal of nonedible parts such as pistil, scale and calyx. Then the florets are cut into small pieces and seasoned with green chili, mustard, and onion and cooked in water. Later it is garnished with coconut gratings. It is good for patients with diabetes or heartburn [51].

3.2. Jackfruit

Jackfruit (*Artocarpus heterophyllus* Lam. Fam. *Moraceae*) is an ancient fruit consumed in Southeast Asia. The edible part of jackfruit includes fruits and seeds. The bioactive compounds such as antioxidants, carotenoids, phenolic compounds and other phytonutrients improve the medicinal value of jackfruits and its seeds [52]. Jackfruit seed chutney (*chekke kuru paji*), *halasu beeja palya*, and roasted/boiled jackfruits seeds are normally consumed in Koorg region in the state of Karnataka.



Fig. 2. Fruit- and vegetable-based traditional health foods.

3.2.1. Jackfruit seed chutney

This is prepared by pounding boiled jackfruit seeds and mixing with chili, onion, garlic, and grated coconut. Salt and lemon juice is added for taste and is served with roti. For make palya, boiled fruit seeds are seasoned with spice ingredients and other vegetables such as green beans and leafy vegetables and served with roti or consumed directly. Jackfruit seed consists of good amount of phenolic compounds and prebiotics. Prebiotics are carbohydrates that help in intestinal microbial balance [52].

3.3. Monkey jack

Monkey jack is an underutilized edible fruit found in Central Western Ghats of Karnataka and other tropical countries. The fruit has medicinal properties and is used to make powder, juice, and *papads* (crispy tortilla). It is a good source of iron and other minerals. It acts as an acidulant and is used instead of tamarind in the preparation of nonvegetarian dishes and *sambar* (lentil-based liquid extract) [53]. Monkey jack powder is known as *vatte pudi* or *esluli pudi*, prepared by pounding sliced fruits with 2–3% salt. Monkey jack juice is prepared from the pulp of fruit. Sugar, cardamom, and black pepper are added to the filtered juice. *Papads* are prepared by making a paste with raw rice, green gram, black gram, and small amount of pepper powder, chili powder, salt and oil. Prepared fresh monkey jack fruit aqueous extract is added to this paste followed by drying on banana leaves. Dried *papads* are roasted on direct fire or fried in oil.

3.4. Bael fruit

Bael fruit (*Aegle marmelos*) is grown in wild areas of India. The bael tree is worshipped in Hinduism, with leaves and fruits of the tree offered to Lord Shiva. Unripe bael fruit exhibits antimicrobial effects and is mainly used for diarrheal treatment in Indian communities [54]. Aegeline, an alkaloid present in the leaves of bael tree, is used as a dietary supplement [55]. A beverage is prepared from the pulp of bael fruit. In some regions of Andhra Pradesh, syrup is prepared from the fruit and used as preserve. For the preparation of syrup, the whole fruit is ruptured and soaked in water overnight, and then it is boiled in the morning along with

soaked water, followed by straining and repeated boiling with sugar to get consistency.

3.5. Mango

The nutraceutical significance of mango with special reference to antioxidants and polyphenols is highly considered. Mango is a rich source of antioxidants, which includes mangiferin, quercetin, kaempferol, gallic acid, and rhamnetin. Mangiferin is a potential antioxidant found in mango. It possesses iron-chelating property. The functional properties of mango help in curing of degenerative diseases [56].

3.5.1. Mango pachadi

This is a special traditional dish of Tamil Nadu prepared during Tamil New Year. It consists of mixture of various tastes such as sweet, salty, bitter, hot and astringent along with the tangy sourness of green mangoes (Fig. 2). For preparation of mango *pachadi*, peeled green mangoes are sliced into thin flat pieces. The sliced mangoes are added to jaggery water. Chili, turmeric, and mustard are used for seasoning. Cooking is done for 15 minutes. The consistency of final dish depends on the quantity of ingredients.

3.5.2. Mango peel chutney

Peel is an edible part of mango. Mango peels are rich sources of dietary fibers and bioactive compounds such as carotenoids, vitamin C, and vitamin E [57]. Mango peel chutney is a traditional food found in south Karnataka. Ripened or unripened mango peels are used for the preparation of chutney. Method of preparation includes seasoning of spices such as clove, mustard, chili, fenugreek seed, black pepper, curry leaves and turmeric powder. Diced mango peels are added to seasoned spices and cooked for 10 minutes. The cooked peels are taken for grinding, after grinding salt is added and served with *roti* or *chapati*.

3.6. Jamun fruit

Jamun fruit (*Syzygium cumini*) belongs to the family Myrtaceae. It is a potential nutraceutical fruit and contains many phytochemicals. Due to the presence of these phytochemicals, it is used to treat

diabetes in India [58,59]. Different parts of the tree including leaf, bark, seed, and pulp, are used in the treatment of diabetes, allergies, viral infection, inflammation, and gastric ulcer [60]. Meanwhile all the parts of Jamun tree have medicinal value. Jamun seed powder is produced commercially by herbal manufacturers in India and is very useful for patients suffering from diabetes. Jamun seeds are used in Ayurveda to treat digestive ailments. Jamun fruit juice is prepared in homes and it is also available commercially.

3.7. Papaya

Papaya (*Carica papaya*) is well known for its nutraceutical values and it is used in traditional medicine system. All the parts of the tree are used in treating one or more diseases. Latex papaya tree is used to relieve dyspepsia, ripe fruits are used in treating chronic diarrhea, unripe fruits are diuretic in nature. Papaya seed juices are used in treatment of bleeding piles and enlarged liver, and young leaf paste is used to treat jaundice [61].

3.7.1. Papaya salad

Papaya salad is prepared in the region of Saurashtra region of Gujarat. It is a side dish eaten with *gathiya*, a popular Gujarat traditional breakfast dish. For the preparation of salad, grated green papaya fruit is used. Coriander seeds and turmeric powder are seasoned in oil, then grated papaya and sugar is added. The mixture is simmered for 5 minutes.

3.8. Bitter gourd

Bitter gourd (*Momordica charantia*) is a vegetable having medicinal properties. Bitter gourd possess antidiabetic activity due to the presence of chranthin, vicine and polypeptide-p [62]. The juice of bitter gourd pulp enhances glucose tolerance in diabetic patients [63]. *Bharwan karela* is a health product prepared from bitter gourd.

3.8.1. Bharwan karela

Ingredients for the preparation of *bharwan karela* are bitter gourd, onions, ginger–garlic paste, turmeric powder, coriander and dry mango powder. First, salt is applied to scraped bitter gourd. After 1 hour, the salt is removed by washing with water. Spices are seasoned with oil, and the bitter gourd is cooked with seasoned spices for 10 minutes. This preparation is good for diabetic patients.

3.9. Green leafy vegetable

Green leafy vegetables are good sources of nutrients and falls in the category of *natural antiaging wonders*. Green leafy vegetables are rich source of vitamins and antioxidants, and many, such as curry leaves, fenugreek, and amaranthus, are used in Indian culinary preparations [64]. Some of the health dishes used in north-east and south India are discussed below.

3.9.1. Spinach roti

Spinach (*Spinacia oleracea*) belongs to the family *Amaranthaceae*. Preparation of *roti* using spinach is very common in south India. Method of preparation includes boiling the spinach in water followed by kneading dough with boiled spinach. Small balls of dough are made into tortillas and roasted. Spinach is a good source of protein and iron [65]. It is recommended for girls during menstruation and for lactating women.

3.9.2. Gundruk

Gundruk is a fermented food prepared from leaves of rayo-sag, mustard, or cauliflower (Fig. 2). Leaves are wilted and shredded, crushed mildly and kept for natural fermentation in airtight jars

and dried after completion of fermentation [66]. Lactic acid bacteria comprising *Lactobacilli*, *Leuconostoc*, and *Pediococcus* are the predominant microorganisms found in gundruk. *Gundruk* soup is also a good appetizer [67]. *Gundruk* has good amount of ascorbic acid, carotene, and lactic acid, and acts as an anticarcinogen [68].

3.9.3. Basle soppu palya

Basle soppu palya is prepared from the leaves of *Baselle alba* L. plant and is mainly consumed in Karnataka region of India. Leaves of the plant are rich source of vitamin C, vitamin A, folic acid, and calcium. Kaempferol is the flavonoid in the *Baselle alba* L. leaf [69]. This dish is good for mouth ulcers and stomach problems and has a cooling effect on the body. *Palya* is prepared by the following method: green fresh leaves are taken and washed, cut into small pieces and mixed with seasoned materials. Amaranth leaves are also added with this leaf. Then it is cooked with or without other beans and served with *roti* or directly consumed.

3.9.4. Saag

Saag is a leaf-based dish prepared in the north east part of India. Green leafy vegetables such as spinach, basella, mustard leaf, or collard greens are used in the preparation of saag (Fig. 2). Preparation includes boiling of chopped green leafy vegetables and other vegetables including radish, tomato, and ginger. Salt and spices are added while cooking. After cooking, it is blended with maize flour, which makes the *saag* smooth and adds flavor. The blended green puree is simmered for 25–30 minutes. *Saag* is served with chopped onions and whole green chilies [70]. *Saag* is prepared from green leafy vegetables and hence possesses a significant amount of minerals and vitamins.

3.9.5. Batua paratha

Batua (*Chenopodium album* L.) belongs to the family *Chenopodiaceae*, a common herb used in the preparation of foods in India. Leaves of the plant contain ascaridole, which is used in the treatment of hookworm and roundworm infection. It demonstrates different medicinal properties including laxative, blood purification, and antiscorbutic [61]. *Batua paratha* is a breakfast food that is available only in winter season. For preparation of the dish, *batua* leaves are cooked in water and cooked leaves are kneaded into dough with wheat flour along with green chili and salt. The kneaded dough are rolled and heated on a pan and can be served with *raita* (mixture of vegetables with yoghurt) or chutneys.

3.9.6. Mulai keerai masail

Mulai keerai masail is an amaranth leaf-based dish eaten as a breakfast food. Amaranth belongs to the family *Amaranthus* L. and is used as a leafy vegetable in India. Mulai keerai masail is prepared in the Tamilnadu state of India but regional names are different: in Andhra Pradesh it is known as *thotakura pappu*, in Kerala it is named *cheera thoran*. Amaranth leaves are good sources of oxalic acid, hence it should be avoided by patients suffering from kidney stones [71]. Dish preparation is the same as *saag*, where leaves are simmered and ground with seasoned spices. Legumes can also be used during preparation, which enhances the nutritive value. This can be eaten along with *chapati* and *roti*.

4. Milk-based health food

Cattle were an integral part of the Vedic culture. Literature before 800 BCE refers to cow, buffalo, and goat milk, which were consumed either fresh or boiled. Sushruta mentions human milk and the milk of the cow, buffalo, goat, and sheep, describing the distinct qualities of each [2]. The major processing products of milk include *ghee*, curd, *paneer*, cheese and buttermilk. Buttermilk was

in wide use, it was turned into a seasoned dish known as *saga*. Curds were eaten with rice and barley. After 800 BCE, the use of colostrum became prevalent and was mixed with boiled milk, crystal sugar, and fragrant herbs [2]. According to the Ayurvedic system, milk has unique nutrition that cannot be provided by any other foods. Here we describe the major health foods prepared from milk.

4.1. Dahi (Indian yoghurt)

Traditionally, *dahi* is a naturally fermented milk product obtained from boiled cow or buffalo milk and soured using mixed lactic cultures. It is used in daily diet as a potential source of B-complex vitamins, folic acid, and riboflavin [72]. *Dahi* is rich in lactic acid bacteria and demonstrates probiotic effect, which helps in intestinal health. Bacterial cultures helps in controlling diarrhea in children [16]. The bioactive compounds produced by lactic acid bacteria such as diacetyl, hydrogen peroxide, and reuterin suppress the normal growth of undesirable flora, especially *E. coli*, *Bacillus subtilis*, and *Staphylococcus aureus* [73]. As storage time increases the sourness of dahi increases, mild heat treatment can be given to increase the shelf life. *Chilika curd* is a region-specific food; it can be found in Odisha state in India and has longer shelf life than normal *dahi*. It is prepared from chilika buffalo milk and is concentrated by boiling. The concentrated milk is poured into pretreated bamboo containers covered with leaves and incubated to prepare the curd. Microbial analysis of chilika curd shows that it contains inherent thermotolerant *Lactobacilli*. The bamboo used in the preparation has certain antifungal agents such as dendrocin, which help to increase the shelf life of curd [74].

4.2. Rabdi

Rabdi is a famous dairy preparation in the north-west part of India. It is a lactic acid-fermented milk product with pearl millet. As compared to other cereals, pearl millet has lower glycemic index, which is helpful in managing noninsulin dependent diabetes mellitus, where primary cause is associated with interruption in carbohydrate metabolism [75].

4.3. Ginna

Ginna is a colostrum-based Indian sweet (Fig. 3). It is also known as *junnu*, *posu*, or *kharvas* in different regions of India. Colostrum is



Fig. 3. Ginna prepared from colostrum.

a rich source of immune components such as immunoglobulins, and iron binding lactoferrin protein, and nutrients such as vitamin A and minerals [76]. *Ginna* is prepared from the 1st day's thick milk (colostrum) of a cow after calving. The colostrum is mixed with normal milk to dilute and with sugar/black jaggery powder. Cardamom is then added for taste followed by cooking in a closed vessel in a pressure cooker. After cooking is complete, the final product is cut into pieces and served with *roti*, *dosa*, or *idli*.

4.4. Sandesh

Sandesh is a protein-rich Indian milk product prepared by heat and acid coagulation. It has a characteristic aroma and is a rich source of vitamins A and D. *Chhena* is the basic ingredient used in the preparation of *sandesh*. Steps in the preparation of *sandesh* include heating of milk to 90–95°C and cooling to 70°C followed by the addition of an acid coagulant. Coagulants used are citric acid, lemon juice, calcium lactate, or sour whey. The addition of coagulant aids in the precipitation of milk and whey is separated by pressing or using muslin cloth. The de-wheyed precipitate called *chhena* is kneaded and mixed with sugar followed by cooking over low flame and cooled [77]. Studies are being conducted to improve the nutritional value of traditional *sandesh* by incorporating herbs that adds to the antioxidant value of the product [78].

4.5. Lassi

Lassi is a traditional milk beverage consumed in summer season for refreshment and is prepared from *dahi* (Indian yoghurt). For the preparation of *lassi*, *dahi* is blended with water, sugar, salt, and spices such as cumin seeds and coriander leaves. The presence of spices decreases thirst. *Lassi* is a probiotic product due to the presence of *L. acidophilus*, and *S. thermophiles* as active cultures [79]. Based on the use of ingredients in *lassi*, it is classified as salty *lassi* or sweet *lassi*. *Bhang lassi* is a special type of *lassi* prepared using the extract of cannabis plant leaves. It is made especially during Holi and Shivarathri festival season. *Bhang lassi* demonstrates health benefits due to the presence of cannabis plant extracts, which help in relieving digestive problems, skin-related problems, fever, and sunstroke [80].

4.6. Buttermilk

Buttermilk is the liquid that is left over when butter is churned out of cream, consumed with or without added salt and spices. It has less fat content and fewer calories compared with regular milk or *dahi*. Buttermilk is as rich a source of calcium and protein as milk. In the states of Gujarat and Rajasthan of India, buttermilk is also called *chaach*. It is easier to digest and, with the presence of live cultures, helps in intestinal health. Buttermilk is consumed with meals and is suggested in the ayurvedic system [81].

5. Ayurvedic health foods

Based on the dominant constituent of the body, *doshas* are classified into *kapha*, *pitta*, and *vatta*. Basic principles of ayurvedic diet are *kedara kulya nyaya*, *khale kapota nyaya*, and *kshira dadhi nyaya*. These three principles describes different aspects of digestion and digested food function in the body [82].

Kedara kulya nyaya is the first principle of ayurvedic diet. This principle describes the initial digestion process, where one of the basic elements, fire, breaks food materials into biological elements (nutrients), which are circulated throughout the body in the *ahara rasa* via the circulatory system. *Khale kapota nyaya* describes selectivity of nutrient by tissues, where every *dhatu* (basic tissue)

selects the specific nutrient for its nourishment. For instance *rasa agni* selects plasma cells, protein molecules are selected by *mamsa* cells (muscle cells), while iron molecules are chosen by *rakta agni*. *Kshira dadhi nyaya* governs transformation of *asthayi dhatu* (immature tissues) into *sthayi dhatu* (mature tissues). *Rasa asthayi dhatu* (immature blood cells) transforms into *sthayi dhatu* (matured blood cells) by the action of *rasa agni*. This principle explains different processes and their concepts involved in growth and development of tissues.

Ayurveda groups five basic elements (ether, air, fire, water, and earth). Essential humors known as *tridosha*, namely *vata*, *pitta*, and *kapha* are composed of these five basic elements. From the ether and air components, the bodily air principle known as *vata* is manifested, which regulates breathing, mobility, and central and sympathetic nervous systems. The fire and water components in the body constitute the fire principle known as *pitta*, which regulates the digestion and assimilation process in the body. The earth and water components known as *kapha* functions in heat regulation, lubrication, and formation of mucus and synovia [83]. These three *doshas* govern all physiopathological, psychological, and biological functions of the body, mind, and consciousness. Imbalance in these *tridoshas* leads to disease or disturbance in body function. For example, air element encourages fire element in the body. Therefore, to control fire element, water element is necessary. For restoration of the balance, dietary recommendations are given according to the individual's body constitution (*vata*, *pitta*, or *kapha*). [84] The recommended guidelines for different body constitution are given in Table 1.

The basic five elements can be related to dietary foods: *ether/space* for popcorn, wafers; *air* for beans, cabbage, cookies; *fire* for chilies, pepper, ginger; *water* for soups, melons; and *earth* for fried foods, cheese. Different combination of these five elements delivers different tastes such as sweet, pungent, sour, bitter, saline, and astringent. Every taste and element combination has an impact on health. For example if water element gives sweet taste, which is responsible for increase in blood production. The majority of earth and fire elements leads to acid taste which helps in digestion and removal of *vata*. Combination of water and fire results in saline taste, which removes *kapha*. Excess combination of air and ether gives a bitter taste, which increases the appetite and removes the harmful *doshas* (pathogenic factor). A pungent taste is the result of predominance of ether and air, which improves digestive power while astringent taste helps in restoring balance between *doshas* [85].

5.1. Liquid foods used in the ayurvedic system

5.1.1. Herbal rice drink

This is a rice-based drink, where dried *churna* (powder) of bark of the tree *Terminalia arjuna* or *Ficus religiosa* (locally known as *arali mara*) is used to increase the medicinal value of drink. The tree is known for its health benefits; in the ayurvedic system it is used for the treatment of heart diseases [9]. On the day of full moon, old red rice (*Athikaraya* var.) is pounded and made into gruel, followed by the addition of cow milk, jaggery, or sugar. The preparation is then processed by cooking. The finished product is placed on copper plate and mixed with the herbal powder which was prepared earlier and kept in moonlight for 4–5 hours. During the full moon, the distance between earth and moon is less and therefore the moon demonstrates its effects on all earthly materials. The radiations absorbed by the drink during the full moon activate the antibiotics and immunoglobulins present in milk and hence it is good for health. After exposure to moon light, it is consumed the next day on an empty stomach. This is very effective for patients with respiratory and asthma problems [24].

Table 1
Dietary guidelines for different body constitution in Ayurveda [84].

Body constitution	Cereals and Pulses	Vegetables and fruits	Spices	Nuts, seeds, and oil	Dairy products
Vata	Use: cooked rice, wheat, ragi and moderate amount of pulses (toor dal, soya bean, moong dal) Avoid: maize, white bread, raw pulses, horse gram.	Use: cooked carrots, beetroots, sweet potato, green beans, onion, capsicum, banana, berries, grapes, citrus, mango, papaya, pineapple Avoid: uncooked vegetable salads, moderate use of greens and sprouts, restrict fibrous and highly sour fruits, dry fruits and pomegranate.	Use: all spices in moderate quantity, coriander, curry leaves, jeera, cinnamon, ginger, garlic, cardamom, mustard, ajwan, turmeric.	Use: all nuts and oils in moderation, almond, cashew, apricot, gingili	Use: lactose intolerance to be taken into consideration, use milk, butter, ghee, cheese, yogurt in moderation
Pitta	Use: rice, wheat, oat, barley, all legumes Avoid: horse gram.	Use: leafy greens, cucumber, red pepper, potato, green beans, broccoli, knol-khol, apple, avocado, sweet orange, papaya, mango, mosambi, melons, pine apple and all sweet fruits. Avoid: all pungent, brinjal, radish, onion/garlic, spinach, banana, grapes, lemon, orange, peaches, plums and sour fruits are restricted.	Use: only small quantities of coriander, cardamom, cinnamon, turmeric, fresh ginger. Avoid: strong spices, chilies, mustard, dry ginger	Use: no nuts except coconut, pumpkin, sunflower, olive, groundnut, soy, coconut oil Avoid: sesame oil, safflower oil, corn oil.	Use: unsalted butter, ghee, milk, sweet yogurt Avoid: sour cream, yogurt (sour), buttermilk, cheese
Kapha	Use: rice (small quantity), corn, dry oats, barley, all pulses Avoid: refined cereals, soya products	Use: raw vegetables, bitter gourd, brinjal, radish, capsicum, spinach, mushroom, all astringent and fibrous fruits, apple, pears, berries, cherries, dry fig, prunes, guava Avoid: sweet and sour fruits, banana, avocado, grapes, lemons, melons, oranges, papaya	Use: all spices are good, black pepper, chilies, ginger, turmeric, coriander, cinnamon, and hing Avoid: salt	Avoid: fried food, all nuts, restrict oil to small seasoning.	Use: no dairy product, non-fat buttermilk Avoid: yoghurt

5.1.2. Halu kashaya

Kashaya means healthy herbal drink in Ayurveda, which is recommended for *pitta dosha*. Sometimes it is referred as decoction of spices or herbs. The basic preparation method includes boiling of water, which is mixed with herbal extracts such as mint, coriander, black pepper, and ginger along with jaggery. After boiling it is strained and mixed with milk. It is very good for cold and fever. One or two pumpkin seeds are taken and pounded with red rice gruel, and grated jaggery is added for taste. It is taken on an empty stomach along with milk, which helps in the development of cranial nerves [24].

5.1.3. Jaljira powder juice

Jaljira powder is mainly used in the north Indian region for the preparation of *jaljira* beverage. This beverage shows cooling effect and is used in the summer for refreshment. *Jaljira* powder can be found in all Ayurvedic medical shops. The basic ingredients used in the preparation of powder are cumin, ginger, black pepper, black salt, and mint. Due to the presence of ginger and black pepper in juice, it can be recommended for people who are having *kapha dosha*. Juice prepared by the powder acts as a good appetizer; mint demonstrates cooling effect, and cumin and black salt aid in good digestion [81].

5.1.4. Nannari sharbat

Nannari sharbat is a traditional herbal beverage prepared using the roots of *Decalepis hamiltonii* (Fig. 4). In Ayurveda the plant is called *Ananthamula*. Beverage is used in summer time for thirst quenching and it acts as a hepatoprotective agent, which is good for stomach health. The roots shows good antioxidant activity and are used to prepare pickles [86,87]. The beverage is recommended for patients suffering from dehydration. To prepare the herbal beverage, fresh roots are collected and dried, then cut into small pieces and powdered. For 1 L of water, 100 g of dried powder is used and soaked for 12 hours. The dispersion is then boiled for 2 hours and sieved to remove the powder sediment. Sugar and water are added to the liquid concentrate and boiled again to obtain the concentrate. The tiny powders or dirt particles are removed from the concentrate through filtration. The concentrated product is stored for later use [88].



Fig. 4. Nannari sharbat prepared using the roots of *Decalepis hamiltonii*

5.1.5. Tambuli

Tambuli is a liquid food that shows cooling properties, is used in south Karnataka. It is a traditional homemade ayurvedic food recommended during the summer season and for those who have high *pitta*. *Tambuli* can be prepared with any edible green leafy vegetables such as palak, curry leaves, or even with pumpkin. It is a good appetizer and used as a starter food. The preparation method for ginger *tambuli* includes grating of ginger and grinding with pepper, jira, and chili. These ingredients are further fried and added to buttermilk. The dispersion is boiled and the remaining buttermilk is added before serving.

5.2. Solid/semisolid foods used in the Ayurveda system

5.2.1. Ondelaga chutney

Ondelaga chutney is made using *Centella asiatica* Urb. Leaf. It is useful mainly for heart disease, cough, and also recommended to children to increase their memory power. *Ondelaga* is a herb by nature and used in ayurvedic medicines, which helps in balancing of *kapha* and *pitta*. Fresh leaf of the plant is collected, washed, and cut into small pieces, seasoned with spices and boiled with green beans or with any legume seeds and then served with roti. The decoction of leaf extraction is taken in empty stomach for heartburn and to reduce blood pressure [89,90].

5.2.2. Neem flower chutney (veppampoo thuvaial)

The neem tree and its different parts have been described in Ayurveda. The small branches of the neem tree are used for the preparation of sticks, which are used for tooth brushing. Neem flower is consumed in the south Indian region of Tamil Nadu as a side dish with rice. Neem flower is known to remove worms and clear away the unwanted substances from the alimentary canal apart from reducing the blood sugar levels. Neem products are recommended by ayurvedic physicians for small children who are having stomach problems. Its bitter taste is reduced during preparation of chutney with sufficient amount of tamarind. The chutney is prepared by grinding roasted neem flower, red chili, *urad dal*, coconut, tamarind, and salt. It is reported that shade-dried neem flower powder has good unsaturated fatty acids such as linolenic, linoleic, and oleic, having good 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging effects. It is also rich in protein [91].

5.2.3. Bamboo shoot curry (kalale sambar)

Bamboo shoots are considered as *nutraceutical medicines* because they have low fat, high edible fiber content, and vitamins such as vitamin C and vitamin E [92]. In the ayurvedic system, bamboo shoot is recommended for patients having piles and burning sensation during urination and is advised to take the shoot *churna* (powder) with honey. North-east Indian people use the fermented bamboo shoots product such as Mesu and Soibum. For the preparation, tender bamboo shoots are used. It is popular in Malenadu region of Karnataka and prepared during the rainy season. The collected shoots are cleaned and chopped, then soaked for 2–3 days to reduce the bitterness. The soaked pieces are taken, boiled for 10 minutes, and followed by adding spices and seasoned lentils. Sometimes pigeon pea can also be used to improve the nutritive value of dish. The dish is well suited with rice and *chapatis*.

6. Miscellaneous health foods

6.1. Koove hittu (*Curcuma angustifolia* Roxb.)

The plant in Hindi called *tikhur* is a medicinal rhizome, belonging to the family Zingiberaceae. *Koove* means *tikhur*, *hittu* means flour. It is also called arrowroot in east India and *koove gida*

Table 2
Classification of weaning foods.

Serial number	Food	Ingredients	Procedure	Reference
1	Malt based foods	Flours of malted foxtail millet, barnyard millet, roasted soybean flour and skim milk powder Flours of malted wheat, chick pea, nonfat dry milk, sucrose Flours of malted finger millet, Green gram Flours of Sorghum malt, Green gram malt, sesame flour	(Fig. 5)	[107] [108,109] [110] [111]
2	Chapati based foods	Wheat, Green gram, Bengal gram Maize, Green gram, Bengal gram Sorghum, Green gram, Bengal gram	(Fig. 6)	[112]
3	Popped food	Pearl millet, Green gram, Bengal gram	—	[112]
4	Flaked food	Rice and soya bean Skim milk powder	—	[112]
5	Shotti	Rhizome of <i>Curcuma angustifolia</i> Roxb.	(Fig. 7)	[113]
6	Sattu	Bengal gram, wheat, jaggery	(Fig. 8)	[114]
7	Banana based weaning food	Ripened banana or banana pulp four and cooked rice		[115]
8	Amaranth based weaning food	Amaranth seeds, green gram, chick pea dal Rice flakes, puffed amaranth		[115] [116]
9	Weaning gruel	Wheat flour, Jaggery, oil, germinated cereal flours (amylase rich food) Spinach or any green leafy vegetable, germinated millet	(Fig. 9)	[117]

in the Kannada language. *Tikhur* rhizome starch is a good appetizer and used for the treatment of ulcers [93]. The starch of this herb is used for the preparation of herbal foods such as *barfi*, *halwa*, and *jalebi*. *Tikhur* starch has cooling effects, so *tikhur sarbat* is prepared in the Chattisgarh region of India during summer [94]. Because of its medicinal property, the starchy flour is used as a weaning food called shotti.

6.1.1. *Tikhur barfi*

For the preparation of *tikhur barfi*, *tikhur* starch, sugar, and water are used in the ratio of 1:1.5:2, respectively [95]. It is especially used in diarrhea. The starch of *tikhur* can also be used for the preparation of cakes, puddings, jellies and biscuits.

6.2. *Bakhar*

Bakhar is a tablet-based preparation found in the Odisha region. It is molded as a tablet which is prepared from rice flour and dry bark or root powder of selected medicinal plants such as *Cissampelos pareira*, *Diospyros melanoxylon*, *Lyngodium flexuosum*, *Orthosiphon rubicundus*, *Ruellia tuberosa*, or *Terminalia alata* [96]. These medicinal plants are used in treatment of renal problems, eczema and colic diseases.

7. Ayurvedic diet in diseases

7.1. Diabetes mellitus

Diabetes is a major health issue in developing countries. Ayurveda not only deals with the diet plan, since its main principles says 'heal/cure yourself through proper diet and exercise'. In Ayurveda, diabetes is known as *madhumeha*, where *madhu* refers to sweet and *meha* refers to urine excretion, i.e. excretion of sweet urine. Three stages of diabetes mellitus according to Ayurveda are *kaphaja prameha* (early), *pittaja prameha* (acute), and *vataja prameha* (chronic). major dietary factors that influence diabetes mellitus are eating excess sugary, salty, or acidic foods. Some animal flesh and fresh grains are also responsible dietary factors for diabetes. Increase in the consumption of fresh and wholesome food can be the cause of noninsulin-dependent diabetes [97]. There are many plants that demonstrates antidiabetic effects such as *Abelmoschus moschatus*, *Acacia arabica*, *Achyranthes aspera*, *Achyrocline satureioides*, *Aegle marmelose*, *Allium cepa*, *Agrimony eupatoria*, *Allium*

sativum, *Aloe barbadensis*, *Aloe vera*, *Anacardium occidentale* L., and *Brassica juncea* [98].

The ayurvedic system has different diet plans for diabetic patients. Foods that possess astringent or bitter taste help in reducing diabetic effect. *Jamun* (*Eugenia jambolana*) seeds *churna* (powder) is very effective in diabetes treatment because of the presence of antidiabetic factors [99]. It is recommended to avoid high sugar and high fat foods and increase the consumption of high fiber foods [100].

7.2. Osteoporosis

Osteoporosis is a musculoskeletal disease caused by decreased bone mineral density and calcium due to deficiency of vitamin D [101]. In Ayurveda science osteoporosis results in the imbalance of *vatta dosha*. The sources of different foods in diet are selected according to season. Milk, white sesame or til seeds are the major sources recommended in the ayurvedic diet for osteoporosis patients. Since these seeds are extremely *pitta* in nature, soaking is needed overnight and the next morning seeds are ingested. During winter, soaking of seeds are not recommended and it can be taken with warm milk. Grains are taken in excess and sprouts are recommended in the diet [102].

8. Weaning foods in Indian tradition

Infants are more vulnerable due to the restricted number of available foods. Exclusive breast feeding for the first 6 months is necessary for a child's growth. At the point when a child reaches

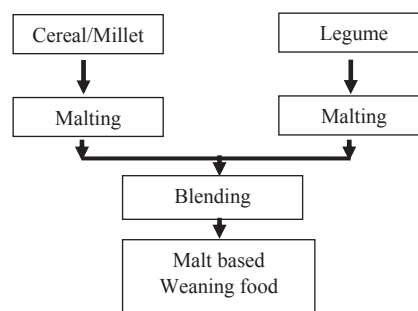


Fig. 5. Preparation of malt-based weaning foods prepared using legume and cereal/millets [115].

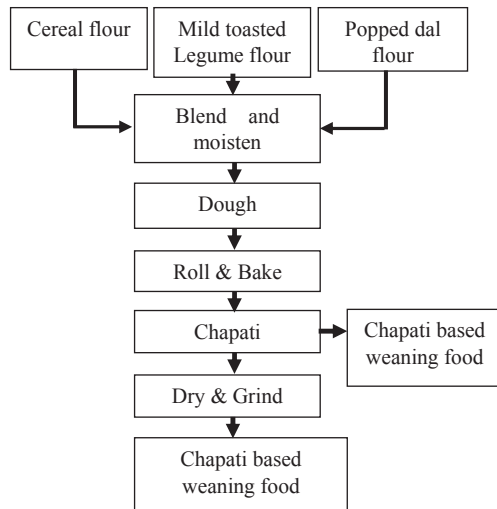


Fig. 6. Preparation of chapati-based weaning foods using cereal flour, legume flour and dhal flour [115].

age 4–6 months, breast milk alone is no longer sufficient to meet the nutritional necessities. Therefore the diet needs to be expanded to include different digestible foods other than breast milk. Weaning foods are the first semisolid foods given to children. The foods are generally mashed and malted and given as gruels. The diet for infants should contain sprouted or soaked cereals, legumes and fruits with low fiber and high ascorbic acid content.

The traditional techniques for making these weaning foods includes malting, germination, and soaking, which helps in lowering the viscosity and reducing the tannins and other components of the food that cannot be digested by the infant. During soaking and germination of grains, phytase activity increases and helps in reduction of phytic acid. This process is important since phytic acid shows negative influence on iron absorption in infants [103–106]. Weaning foods that are exclusively available in India are listed in Table 2 [107–117]. In case of formulation of legume based weaning foods, use of about 5% cereal malt helps in predigestion of starch as it contains amylase and reduces the dietary bulk of weaning food. Care should be taken on antinutritional factors such as trypsin inhibitor [107].

Malt-based foods are prepared from malted flours of cereals, millets and legumes. The malting process improves the nutritional value of food. Malting of grains is done by steeping and germination, followed by drying and grinding. Since malting decreases the size of particles, the preparation of porridge or thick juice becomes easy and is easily digestible. The unit operations involved in the

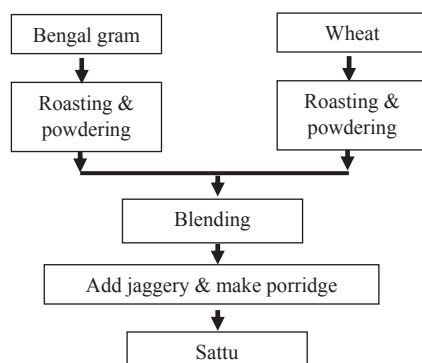


Fig. 7. Preparation of sattu using Bengal gram and wheat [114].

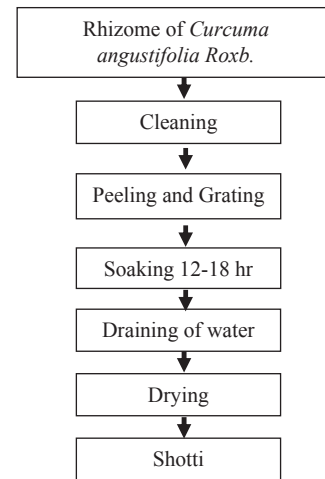


Fig. 8. Preparation of shotti using rhizome of *Curcuma angustifolia* Roxb. [113].

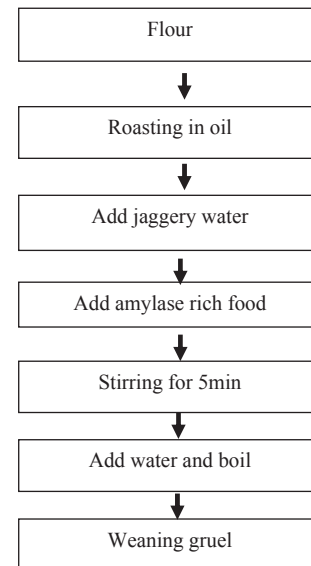


Fig. 9. Preparation of weaning gruel [117].

preparation of malt based weaning food is shown in Fig. 5. Chapati-based foods are given to children aged 1–2 years. Instead of making porridge of malted grains, a combination of grains is made into dough and used for preparation of chapati. Chapatis are given to children to improve chewing strength. The unit operations involved in the preparation of chapati product is demonstrated in Fig. 6. Sattu, another weaning food product is prepared from Bengal gram and wheat (Fig. 7). Shotti is a rhizome based weaning product, prepared from *Curcuma angustifolia* Roxb. (Fig. 8). Gruel-based foods are prepared by boiling amylase rich grains and leafy vegetables together in jaggery water. Gruel is a good source of water-soluble vitamins (Fig. 9).

9. Conclusion

There is so much diversity in traditional health foods of India because the regional health foods have evolved according to the climate, culture, and cropping practices of a particular region. Moreover, certain foods have become more popular in certain region according to the health condition of a population such as

lactose intolerance in Bengal leads to popularization of lactose-free dairy sweets. A national research project in India is recommended to scientifically document the health benefits of traditional and ayurvedic health foods across various regions so that a database can be created for preservation of knowledge on processing, preservation and dietary guidelines on traditional and ayurvedic foods for the benefit of both the Indian and international communities.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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